

11

66 in rapid succession. In this manner, the tractor 10 is used to ram the push rod cable 46 and lateral camera 44 into the lateral sewer pipe 14 and against the obstruction. The tractor motor 36 is more powerful than the drive motor 82, and is therefore better able to overcome obstacles in the lateral sewer pipe 14. The tractor motor 36 may be rapidly switched between the reverse gear and forward gear settings several times to facilitate ramming the lateral camera 44 through or past the obstruction.

The lateral camera 44 is further assisted and caused to roll or twist by rotating and tilting the launch chute assembly 38. Therefore, the rotate and tilt motors 84, 86 are also used to overcome obstacles encountered within the lateral sewer pipe 14.

Although particular embodiments of the present invention have been shown and described, other alternative embodiments will be apparent to those skilled in the art and are within the intended scope of the present invention. Thus, the present invention is to be limited only by the following claims.

I claim:

1. An apparatus for inspecting a lateral conduit from a main conduit, the apparatus comprising:

- a frame;
- a drive motor interconnected with the frame;
- at least one drive gear selectively rotated by the drive motor in one of an insertion direction and a retraction direction;
- a push rod cable engaged by the at least one drive gear such that rotation of the at least one drive gear in the insertion and retraction directions causes respective insertion and retraction of the push rod cable with respect to the lateral conduit, the push rod cable including
 - a core having sufficient longitudinal compressive rigidity to allow insertion of the push rod cable into the lateral conduit and having sufficient transverse flexibility to negotiate substantially all bends within the lateral conduit,
 - a push rod circuitry disposed along an outside surface of the core; and
 - a lateral camera interconnected with the push rod cable for insertion into the lateral conduit with the push rod cable, wherein the push rod circuitry contains the necessary electrical and video circuitry to operate the lateral camera;
- a movable friction member interconnected with the frame for movement with respect to the frame, and adapted to frictionally engage an inner surface of a wall of the main conduit; and
- a propulsion motor interconnected with the frame, and operatively interconnected with the movable friction member for selective movement of the friction member to cause movement of the apparatus in one of a forward and reverse direction with respect to the main conduit.

2. The apparatus of claim 1, wherein the push rod cable includes a shell substantially encasing the push rod circuitry and the core.

3. The apparatus of claim 2, wherein the drive gear frictionally engages an outer surface of the shell.

4. The apparatus of claim 2, wherein the drive gear includes a plurality of drive gear teeth that at least partially impinge on an outer surface of the shell to facilitate insertion and retraction of the push rod cable with respect to the lateral conduit.

5. The apparatus of claim 2, further comprising at least one pressure roller, wherein the at least one pressure roller

12

applies pressure to a portion of the push rod cable to facilitate engagement of an outer surface of the shell by the at least one drive gear.

6. The apparatus of claim 5, wherein the at least one pressure roller includes at least one spring that biases the at least one pressure roller against the push rod cable.

7. The apparatus of claim 6, wherein the at least one spring enables the at least one pressure roller to apply about 80-100 psi pressure to the portion of the push rod cable.

8. The apparatus of claim 5, wherein the at least one drive gear includes three drive gears, and wherein the at least one pressure roller includes three pressure rollers.

9. The apparatus of claim 1, further comprising a remote control station and a supply cable interconnecting the remote control station with the apparatus, the supply cable including all electrical and video circuitry necessary to operate the apparatus from the control station and to allow inspection of the lateral conduit through the lateral camera.

10. The apparatus of claim 1, wherein the propulsion motor is more powerful than the drive motor, and wherein the drive motor is adapted to be selectively locked, thereby preventing rotation of the at least one drive gear in either the insertion direction or retraction direction to permit the propulsion motor to be engaged to move the apparatus in the forward direction and in the reverse direction in rapid succession to overcome an obstruction encountered within the lateral conduit.

11. The apparatus of claim 1, further comprising:

- a launch chute assembly interconnected with a front portion of the frame, the launch chute assembly at least partially supporting the lateral camera when the lateral camera is in a fully retracted position; and
- a rotate motor interconnected with the frame and with the launch chute assembly, and adapted to selectively rotate the launch chute assembly in one of a clockwise and a counterclockwise direction about a rotate axis that is generally parallel to the longitudinal axis.

12. The apparatus of claim 11, further comprising a main camera interconnected with the launch chute assembly for rotation therewith about the rotate axis.

13. The apparatus of claim 12, further comprising a remote control station and a supply cable interconnecting the remote control station with the apparatus, the supply cable including all electrical and video circuitry necessary to operate the apparatus from the control station, the relative positions of the lateral camera and an opening to the lateral conduit being viewable through the main camera from the remote control station, wherein the lateral conduit may be inspected through the lateral camera from the remote control station.

14. The apparatus of claim 11, wherein the launch chute assembly includes a launch chute member, and wherein the lateral camera is at least partially supported by the launch chute when the lateral camera is in the fully retracted position.

15. The apparatus of claim 14, wherein the launch chute member defines a channel in which the lateral camera is at least partially housed when the lateral camera is in the fully retracted position.

16. An apparatus for inspecting a lateral conduit from a main conduit, the apparatus comprising:

- a frame;
- a drive motor interconnected with the frame;
- at least one drive gear selectively rotated by the drive motor in one of an insertion direction and a retraction direction;

13

- a push rod cable engaged by the at least one drive gear such that rotation of the at least one drive gear in the insertion and retraction directions causes respective insertion and retraction of the push rod cable with respect to the lateral conduit, the push rod cable including 5
 - a core having sufficient longitudinal compressive rigidity to allow insertion of the push rod cable into the lateral conduit and having sufficient transverse flexibility to negotiate substantially all bends within the lateral conduit, and 10
 - a push rod circuitry disposed along an outside surface of the core;
 - a lateral camera interconnected with the push rod cable for insertion into the lateral conduit with the push rod cable, wherein the push rod circuitry contains the necessary electrical and video circuitry to operate the lateral camera; 15
 - a launch chute assembly interconnected with a front portion of the frame, the launch chute assembly at least partially supporting the lateral camera when the lateral camera is in a fully retracted position; 20
 - a rotate motor interconnected with the frame and with the launch chute assembly and adapted to selectively rotate the launch chute assembly in one of a clockwise and a counterclockwise direction about a rotate axis that is generally parallel to the longitudinal axis; 25
 - the launch chute assembly including a launch chute member; 30
 - said lateral camera being at least partially supported by the launch chute member when the lateral camera is in the fully retracted position; and
 - a tilt motor operably interconnected with the launch chute assembly to selectively raise and lower the launch chute member and the lateral camera with respect to the rotate axis. 35
17. An apparatus for inspecting a lateral conduit from a main conduit, the apparatus comprising: 40
- a frame;
 - a drive motor interconnected with the frame;
 - at least one drive gear selectively rotated by the drive motor in one of an insertion direction and a retraction direction; 45
 - a push rod cable engaged by the at least one drive gear such that rotation of the at least one drive gear in the

14

- insertion and retraction directions causes respective insertion and retraction of the push rod cable with respect to the lateral conduit the push rod cable including
- a core having sufficient longitudinal compressive rigidity to allow insertion of the push rod cable into the lateral conduit and having sufficient transverse flexibility to negotiate substantially all bends within the lateral conduit, and
- a push rod circuitry disposed along an outside surface of the core;
- a lateral camera interconnected with the push rod cable for insertion into the lateral conduit with the push rod cable, wherein the push rod circuitry contains the necessary electrical and video circuitry to operate the lateral camera;
- a launch chute assembly interconnected with a front portion of the frame, the launch chute assembly at least partially supporting the lateral camera when the lateral camera is in a fully retracted position;
- a rotate motor interconnected with the frame and with the launch chute assembly, and adapted to selectively rotate the launch chute assembly in one of a clockwise and a counterclockwise direction about a rotate axis that is generally parallel to the longitudinal axis; and
- said launch chute assembly including
 - a first bracket interconnected with the frame and rotatable by the rotate motor about the rotate axis;
 - a second bracket interconnected with the first bracket for rotation therewith about the rotate axis and pivotable with respect to the first bracket about a first transverse axis that is substantially normal to the rotate axis, the second bracket defining a channel in which the lateral camera is at least partially housed when in the fully retracted position;
 - a third bracket interconnected with the second bracket for rotation therewith about the rotate axis, the second and third brackets pivotal with respect to each other about a second transverse axis that is substantially normal to the rotate axis; and
 - a tilt motor interconnected with the third bracket to selectively move the third bracket toward or away from the tilt motor, thereby causing the second bracket to raise or lower the lateral camera with respect to the rotate axis.

* * * * *

18. An apparatus for inspecting a lateral conduit from a main conduit, the apparatus comprising:

a frame;

a push rod cable movable in an insertion direction and a retraction direction with respect to the lateral conduit;

a lateral camera interconnected with the push rod cable for insertion into the lateral conduit with the push rod cable;

a movable friction member interconnected with the frame for movement with respect to the frame, and adapted to frictionally engage an inner surface of a wall of the main conduit; and

a propulsion motor carried by the frame, and operatively interconnected with the movable friction member to cause movement of the friction member to move the apparatus with respect to the main conduit.

19. The apparatus of claim 18, further comprising a remote control station and a supply cable interconnecting the remote control station with the apparatus, the supply cable including all electrical and video circuitry necessary to operate the apparatus from the control station and to allow inspection of the lateral conduit through the lateral camera.

20. The apparatus of claim 18, further comprising a drive motor interconnected with the frame, the drive motor causing the push rod to move in the insertion and retraction directions.

21. The apparatus of claim 20, wherein the propulsion motor is more powerful than the drive motor, and wherein the drive motor is adapted to be selectively locked, thereby preventing insertion and retraction of the push rod cable with respect to the lateral conduit, to permit the propulsion motor to move the apparatus in forward and reverse directions with respect to the main conduit in rapid succession to overcome an obstruction encountered within the lateral conduit.

22. An apparatus for inspecting a lateral conduit from a main conduit having a longitudinal axis, the apparatus comprising:

- a frame;
- a push rod cable selectively movable in an insertion direction and a retraction direction with respect to the lateral conduit;
- at least one camera supported by the frame;
- a tilt motor selectively tilting the at least one camera with respect to the longitudinal axis of the main conduit; and
- a rotate motor rotating the at least one camera about an axis of rotation that is substantially parallel to the longitudinal axis of the main conduit, the tilt motor and rotate motor cooperating to scan substantially the entire inner surface of the main conduit with the at least one camera.

23. The apparatus of claim 22, further comprising a launch chute assembly, the at least one camera including a lateral camera interconnected with the push rod cable and supported by the launch chute assembly, the launch chute assembly being selectively tilted by the tilt motor to tilt the lateral camera with respect to the longitudinal axis of the main conduit.

24. The apparatus of claim 23, wherein the rotate motor is interconnected with the launch chute assembly to cause the launch chute assembly to rotate about an axis of rotation.

25. The apparatus of claim 24, further comprising a bracket interconnected with the launch assembly, wherein the at least one camera also includes a main camera mounted to the bracket and rotatable about the axis of rotation under the influence of the rotate motor.

26. The apparatus of claim 22, further comprising:

a movable friction member interconnected with the frame for movement with respect to the frame, and adapted to frictionally engage an inner surface of a wall of the main conduit; and

a propulsion motor interconnected with the frame and operatively interconnected with the movable friction member for selective movement of the friction member to cause movement of the apparatus in a direction substantially parallel to the longitudinal axis of the main conduit.

27. The apparatus of claim 22, further comprising a drive motor interconnected with the frame, the drive motor causing the push rod to move in the insertion and retraction directions.